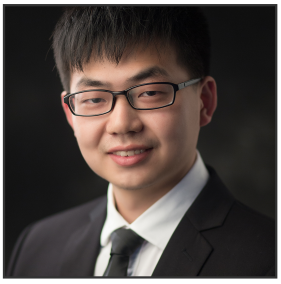

Zhao **FENG**

Mechatronic Engineering · Ph.D

School of Power and Mechanical Engineering, Wuhan University, No. 8, South Donghu Road, Wuchang District,Wuhan, Hubei Province, P.R. China 430072

(+86) 18707192582 | fengzhaozhao7@whu.edu.cn; fengzhao92@outlook.com | orcid.org/0000-0001-7213-9413

"What doesn't kill you makes you stronger."

Summary

From October 2022, I become an associate professor in the School of Power and Mechanical Engineering, Wuhan University, and joint the Advanced Robotics and Intelligent Control Laboratory (ARIC). I received the B.S degree from the School of Power and Mechanical Engineering, Wuhan University, China in June 2014, and PH.D. degree of Mechatronic Engineering from the School of Power and Mechanical Engineering, Wuhan University, China in June 2020. I also studied at the Department of Electrical and Computer Engineering, National University of Singapore (NUS), Singapore, for one year as a joint PhD student. From October 2020 to October 2022, I was a research fellow sponsored by the UM Macao Postdoctoral Associateship (UMPA) at the Department of Electrical and Computer Engineering, Faculty of Science and Technology, University of Macau. My research interests include iteration learning control, sliding mode and adaptive control, impedance control for precision position or force tracking with applications to piezoelectric-actuated devices, such as nanopositioning stages and ear surgical device. My website can be found here (`https://mefengzhao.github.io/`).

Experience

Wuhan University — *School of Power and Mechanical Engineering*

Associate Professor — *2022.10 - now*

University of Macau (Supervisor: Prof. Feng WAN) — *Department of Electrical and Computer Engineering*

Research Fellow (UM Macao Postdoctoral Associateship) — *2020.10 - 2022.10*

Wuhan University (Supervisor: Prof. Xiaohui XIAO) — *School of Power and Mechanical Engineering*

PhD in Mechatronic Engineering — *2014.09 - 2020.06*

National University of Singapore (Supervisor: Prof. Tong Heng LEE and Prof. Kok Kiong TAN) — *Department of Electrical and Computer Engineering*

Joint PhD student (Sponsored by China Scholarship Council) — *2019.01 - 2020.03*

Wuhan University (Supervisor: Prof. Xiaohui XIAO) — *School of Power and Mechanical Engineering*

B.Eng. in Mechanical Design, Manufacturing and Automation — *2010.09 - 2014.06*

Research

Research Interests

Controller Design

- Mechatronics, compliant mechanisms,robotics
- Damping controller design for high-bandwidth position tracking
- Iterative learning and repetitive control, disturbance/state observer technology
- Sliding mode control, adaptive control, force and impedance control

Research Applications

Experimental Test

- 3-DoF piezoelectric actuator-driven nanopositioner for high-speed and precision motion or positioning for image scanning of scanning probe microscopes
- Piezoelectric actuator-based ear surgical device with application to office-based myringotomy and grommet insertion for patients with otitis media with effusion

Projects

Fast and Precise Control of Micro-Manipulators Based on Error Compensation Strategy in Frequency Domain — *Wuhan University*

Natural Science Foundation of China (Grant No. 51375349), Participant — *2014.09 - 2017.12*

- Set up experimental platform based on Simulink Real-Time with data acquisition card (PCI 6289, National Instrument) and a 3-DoF piezoelectric actuator-driven nanopositioner (P-561.3CD, Physik Instrumente)
- Design a data-based feedforward controller for a coupled parallel nanopositioning stage to eliminate the cross-coupling effects and hysteresis nonlinearity without any modeling process for fast repetitive motion
- Propose the bandwidth-enhanced damping controller to make the closed-loop bandwidth exceeds the dominating resonant frequency in order to improve motion speed
- Linear time-varying Q-filter design for high-bandwidth and flexible tracking via discrete wavelet transform to make iterative learning control track varying references

Rapid and Precise Motion Control of Micro-manipulators for Multi-axis and Multi-Task Applications — *Wuhan University*

Shenzhen Science and Technology Program (Grant No. JCYJ20170306171514468), Participant — *2017.05 - 2019.05*

- Set up experimental platform based on a real-time controller (MicroLabBox, dSPACE) and a linear motor motion stage (LMAC-ES17065-4, AEROTECH)
- Flexible tracking for multi-task applications based on model-data iterative learning control
- Design of disturbance rejection method through repetitive control and disturbance or extend state observer to improve the robustness of the system
- Multi-axis linear and nonlinear contour tracking based on position domain iterative learning control algorithm
- Design a novel signal-transformation based repetitive controller dedicated to accurate and fast tracking of spiral trajectory with simple structure and less parameters

Office-based Ventilation Tube Applicator for Patients with Otitis Media with Effusion — *National University of Singapore*

Science and Engineering Research Council (SERC), Singapore (SERC Grant No. 103 149 0002), Participant — *2019.01 - 2020.01*

- Develop an adaptive integral terminal sliding mode force control scheme for the piezoelectric actuator-based ear surgical device to achieves desired force tracking without modeling the complex soft interaction
- Formulate the integral terminal sliding mode based adaptive integral backstepping control to accommodate friction, hysteresis nonlinearity, model uncertainties as well as external disturbance and retain high tacking precision for the ear surgical device
- Propose an integral backstepping impedance force control for precision interaction force tracking on soft environment based on nonlinear Hunt-Crossley model with experimental verification
- Develop an adaptive integral terminal sliding-mode-based impedance control for the piezoelectric actuator-based ear surgical device with soft interaction to regulate position and force simultaneously with experiments on a mock membrane

Skills

Language

Communication

Native in Chinese; Fluent in English (IELTS: 6.5)

Software

Programming

MATLAB/Simulink, LabVIEW, Python, dSPACE, LaTeX, Microsoft Office

Honors & Awards

International

2020.04 **Recepient,** UM Macao Postdoctoral Associateship (UMPA) — *University of Macau*

2016.08 **Best Student Paper Award,** International Conference on Intelligent Robotics and Applications — *Tokyo, Japan*

2018.07 **Finalist,** IEEE International Conference on Advanced Robotics and Mechatronics (ICARM) — *Singapore*

Domestic

2012.12 **3rd Prize Scholarship,** Semester year of 2011 as undergraduate (top 15%) *Wuhan University*

2013.12 **1st Prize Scholarship,** Semester year of 2012 as undergraduate (top 5%) *Wuhan University*

2013.12 **National Encouragement Scholarship,** Semester year of 2012 as undergraduate (top 2%) *Wuhan University*

2014.06 **Outstanding Graduate,** Undergraduate students in Wuhan University *Wuhan University*

2017.09 **2nd Prize Scholarship,** Semester year of 2016 as graduate *Wuhan University*

2018.06 **State Scholarship,** As a Joint PH.D. student supported by China Scholarship Council(CSC) *CSC*

2020.06 **Outstanding Graduate,** Graduate students in Wuhan University *Wuhan University*

Publications

Journal Papers (First Author)

1. **Feng, Z.**, Liang, W.Y., Ling, J., Xiao, X.H., Tan, K.K., & Lee, T.H. Precision Force Tracking Control of a Surgical Device Interacting With a Deformable Membrane. **IEEE/ASME Transactions on Mechatronics**, Accept. (**SCI, IF=5.867, Q1, Top**)
2. **Feng, Z.**, Liang, W.Y., Ling, J., Xiao, X.H., Tan, K.K.,& Lee, T.H. Adaptive Robust Impedance Control for an Ear Surgical Device with Soft Interaction. **IEEE/ASME Transactions on Mechatronics**, Accepted. (**SCI, IF=5.867, Q1, Top**)
3. **Feng, Z.**, Ming, M., Ling, J., Xiao, X.H., Yang, Z.X.,& Wan, F. (2022). Fractional Delay Filter based Repetitive Control for Precision Tracking: Design and Application to a Piezoelectric Nanopositioning Stage. **Mechanical Systems and Signal Processing**, 164, 108249. (**SCI, IF=8.934, Q1, 1Top**)
4. **Feng, Z.**, Liang, W.Y., Ling, J., Xiao, X.H., Tan, K.K.,& Lee, T.H. (2020). Integral Terminal Sliding Mode based Adaptive Integral Backstepping Control for Precision Motion of a Piezoelectric Ultrasonic Motor. **Mechanical Systems and Signal Processing**, 144, 106856. (**SCI, IF=8.934, Q1, Top**)
5. **Feng, Z.**, Ling, J.,Ming, M., Liang, W.Y., Tan, K.K., & Xiao, X.H. (2020). Signal-transformation-based Repetitive Control of Spiral Trajectory for Piezoelectric Nanopositioning Stages. **IEEE/ASME Transactions on Mechatronics**, 25(3), 1634-1645. (**SCI, IF=5.867, Q1, Top**)
6. **Feng, Z.**, Ling, J., Ming, M., & Xiao, X.H. (2019). Integrated Modified Repetitive Control with Disturbance Observer of Piezoelectric Nanopositioning Stages for High-speed and Precision Motion. ***Journal of Dynamic Systems, Measurement, and Control***, 141(8), 081006. (**SCI, IF=1.640, Q4**)
7. **Feng, Z.**, Ling, J., Ming, M., & Xiao, X.H. (2018). A Model-data Integrated Iterative Learning Controller for Flexible Tracking with Application to a Piezo Nanopositioner. ***Transactions of the Institute of Measurement and Control***, 40(10), 3201-3210. (**SCI, IF=2.146, Q3**)
8. **Feng, Z.**, Ling, J., Ming, M., & Xiao, X.H. (2017). Data-based Double-feedforward Controller Design for a Coupled Parallel Piezo Nanopositioning Stage. ***Proceedings of the Institution of Mechanical Engineers, Part I: Journal of Systems and Control Engineering***, 231(10), 881-892. (**SCI, IF=1.623, Q4**)
9. **Feng, Z.**, Ling, J., Ming, M., & Xiao, X.H. (2017). High-bandwidth and Flexible Tracking Control for Precision Motion with Application to a Piezo Nanopositioner. ***Review of Scientific Instruments***, 88(8), 085107. (**SCI, IF=1.843, Q3**)
10. **Feng, Z.**, Ling, J., Ming, M., & Xiao, X. H. (2018). Precision Motion Control for a Piezoelectric Micro-positioning Stage via Integrating Iterative Learning and Disturbance Observer. ***Robot***, (6), 825-834. (**EI**)

Conference Papers (First Author)

1. **Feng, Z.**, Ling, J., & Shen, Y. (2022, August). Discrete-Time Integral Terminal Sliding Mode based Repetitive Control for Periodic Motion Tracking. In 2022 IEEE 11th Data Driven Control and Learning Systems Conference (**DDCLS'22**) (pp. 1031-1036). (**EI**)
2. **Feng, Z.**, Ling, J., Wan. F., & Yang, Z. X. (2021, May). Iterative Learning Enhanced Integral Terminal Sliding Mode Control for Precision Motion Systems. 2021 IEEE 10th Data Driven Control and Learning Systems Conference (**DDCLS'21**) (pp. 778-783). (**EI**)
3. Liang, W. Y#., **Feng, Z.#**(), Wu, Y., Gao, J., Ren, Q., & Lee, T. H. (2020, August). Robust Force Tracking Impedance Control of an Ultrasonic Motor-actuated End-effector in a Soft Environment. In 2020 IEEE/RSJ International Conference on Intelligent Robots and Systems (**IROS**) (pp. 7716-7722). (**EI**)
4. **Feng, Z.**, Ling, J., Ming, M., & Xiao, X.H. (2019, August). Model-assisted Extended State Observer based Repetitive Control for High Precision Tracking of Piezoelectric Nanopositioning Stages. In 38th Chinese Control Conference (**CCC2019**). (**EI**)
5. **Feng, Z.**, Ling, J., Ming, M., & Xiao, X.H. (2016, August). Data-driven Feedforward Decoupling Filter Design for Parallel Nanopositioning Stages. In International Conference on Intelligent Robotics and Applications (**ICIRA**) (pp. 709-720). Springer, Cham. (**EI**)

Co-author papers

1. Ling, J., **Feng, Z.**, Chen, L., Zhu, Y., & Pan, Y. (2023). Neural network-based iterative learning control of a piezo-driven nanopositioning stage. **Precision Engineering**, 81, 112-123. (**SCI, IF=3.315, Q2**)
2. Ling, J., Ye, T., **Feng, Z.**, Zhu, Y., Li, Y., & Xiao, X.H (2022). A Survey on Synthesis of Compliant Constant force/torque Mechanisms. **Mechanism and Machine Theory**, 176, 104970. (**SCI, IF=4.930, Q1, Top**)
3. Ling, J., Chen, L., **Feng, Z.**, & Zhu, Y. (2022). Development and test of a high speed pusher-type inchworm piezoelectric actuator with asymmetric driving and clamping configuration. **Mechanism and Machine Theory**, 176, 104997. (**SCI, IF=4.930, Q1, Top**)

4. He, S., Lu, H.,**Feng, Z.**, & Xiao, X.H. Position Tracking for Multi-Channel Double-Crystal Monochromator Scanning Based on Iterative Learning Control. **Actuators** (Vol. 11, No. 7, p. 177). (**SCI, IF=2.523, Q3**)
5. Chen, L., Zhu, Y., Ling, J., & **Feng, Z.** (2022). Theoretical Modeling and Experimental Evaluation of a Magnetostrictive Actuator with Radial-nested Stacked Configuration. **Nonlinear Dynamics**, 1-17. (**SCI, IF=5.741, Q1**)
6. Ren, Q., Zhu, W., **Feng, Z.**, & Liang, W.Y. (2021). Learning-Based Force Control of a Surgical Robot for Tool-Soft Tissue Interaction. ***IEEE Robotics and Automation Letters***, 6(4), 6345-6352. (**SCI, IF=4.321, Q2**)
7. Ming, M., Liang, W.Y., **Feng, Z.**, Ling, J., Al Mamun, A., & Xiao, X.H. (2021). PID-type Sliding Mode-based Adaptive Motion Control of a 2-DOF Piezoelectric Ultrasonic Motor Driven Stage. ***Mechatronics***, 76, 102543. (**SCI, IF=3.379, Q2**)
8. Ling, J., **Feng, Z.**, Kang, X., & Xiao, X.H. (2021). Bandwidth Enhancement in Damping Control for Piezoelectric Nanopositioning Stages with Load Uncertainty: Design and Implementation. ***Journal of Vibration and Control***, 27(11-12), 1382-1394.(**SCI, IF=2.633, Q2**)
9. Chen, L., Zhu, Y.C., Ling, J., & **Feng, Z.** (2021). Development and Test of a Two-dimensional Stacked Terfenol-D Actuator with High Bandwidth and Large Stroke. ***IEEE/ASME Transactions on Mechatronics***, 26(4), 1951-1959. (**SCI, IF=5.867, Q1,Top**)
10. Qiu, C.C., Ling, J., Zhang, Y.K., Ming, M.,**Feng, Z.**, & Xiao, X.H. (2021). A Novel Cooperative Compensation Method to Compensate for Return Stroke of Stick-slip Piezoelectric Actuators. ***Mechanism and Machine Theory***, 159, 104254. (**SCI, IF=4.930, Q1,Top**)
11. Ye, T.T., Ling, J., Kang, X., **Feng, Z.**, & Xiao, X.H. (2021). A Novel Two-stage Constant Force Compliant Micrograpper. ***Journal of Mechanical Design***, 143(5). (**SCI, IF=3.251, Q2**)
12. Ling, J.,**Feng, Z.**, Zheng, D., Yang, J., Yu, H., & Xiao, X.H. (2021). Robust Adaptive Motion Tracking of Piezoelectric Actuated Stages using Online Neural-network-based Sliding Mode Control. ***Mechanical Systems and Signal Processing***, 150, 107235. (**SCI, IF=8.934, Q1, Top**)
13. Ming, M., **Feng, Z.**,Ling, J., & Xiao, X.H. (2020). Disturbance Observer based Model Prediction Control with Real-time Modified Reference for a Piezo-actuated Nanopositioning Stage. ***Transactions of the Institute of Measurement and Control***, 42(4), 813-822. (**SCI, IF=2.146, Q3**)
14. Ling, J., **Feng, Z.**, Ming, M., Guo, Z., & Xiao, X.H. (2019). Signal Transformed Internal Model Control for Non-raster Scanning of Piezo-actuated Nanopositioning Stages. ***International Journal of Control, Automation and Systems***,18(8), 1915-1925. (**SCI, IF=2.964, Q2**)
15. Ling, J., **Feng, Z.**, Ming, M., & Xiao, X.H. (2019). Model Reference Adaptive Damping Control for a Nanopositioning Stage with Load Uncertainties. **Review of Scientific Instruments**, 90(4), 045101. (**SCI, IF=1.843, Q3**)
16. Ling, J., Rakotondrabe, M., **Feng, Z.**, Ming, M., & Xiao, X.H. (2019). A Robust Resonant Controller for High-Speed Scanning of Nanopositioners: Design and Implementation. ***IEEE Transactions on Control Systems Technology***. 28(3), 1116-1123. (**SCI, IF=5.418, Q1**)
17. Ming, M., Ling, J., **Feng, Z.**, & Xiao, X.H. (2018). A Model Prediction Control Design for Inverse Multiplicative Structure based Feedforward Hysteresis Compensation of a Piezo Nanopositioning Stage. ***International Journal of Precision Engineering and Manufacturing***, 19(11), 1699-1708. (**SCI, IF=2.041 , Q4**)
18. Ming, M., **Feng, Z.**, Ling, J., & Xiao, X. H. (2018). Hysteresis Modelling and Feedforward Compensation of Piezoelectric Nanopositioning Stage with a Modified Bouc-Wen Model. ***Micro& Nano Letters***, 13(8), 1170-1174. (**SCI, IF=0.98, Q4**)
19. Ling, J., **Feng, Z.**, Yao, D., & Xiao, X.H. (2018). Non-linear Contour Tracking using Feedback PID and Feedforward Position Domain Cross-coupled Iterative Learning Control. ***Transactions of the Institute of Measurement and Control***, 40(6), 1970-1982. (**SCI, IF=2.041, Q4**)
20. Ling, J., **Feng, Z.**, Ming, M., & Xiao, X.H. (2018). Damping Controller Design for Nanopositioners: A Hybrid Reference Model Matching and Virtual Reference Feedback Tuning Approach. ***International Journal of Precision Engineering and Manufacturing***, 19(11), 1699-1708. (**SCI, IF=2.041, Q4**)
21. Ling, J., **Feng, Z.**, Ming, M., & Xiao, X.H. (2018). Precision Contour Tracking using Feedback-feedforward Integrated Control for a 2-DOF Manipulation System. **International Journal of Robotics & Automation**, 33(3), 276-283. (**SCI, IF=1.041, Q4**)
22. Ling, J., Ming, M., **Feng, Z.**, & Xiao, X.H (2017). A Master-slave Cross-coupled Iterative Learning Control for Repetitive Tracking of Nonlinear Contours in Multi-axis Precision Motion Systems. ***ACTA AUTOMATICA SINICA***, 43(12), 2127-2140. (**EI**)
23. Ming, M., Liang, W.Y., Ling, J., **Feng, Z.**, Al Mamun, A., & Xiao, X.H. (2020, October). Composite Integral Sliding Mode Control with Neural Network-based Friction Compensation for a Piezoelectric Ultrasonic Motor. In IECON 2020 The 46th Annual Conference of the IEEE Industrial Electronics Society (**IECON 2020**) (pp. 4397-4402). IEEE. (**EI**)
24. Ling, J., Ye, T.T., **Feng, Z.**, Ming, M., & Xiao, X.H. (2019, October). Damping Controller Design for Triangular Scanning of a Third-Order Nanopositioning Stage. In 2019 19th International Conference on Control, Automation and Systems (**ICCAS**) (pp. 412-417). IEEE. (**EI**)
25. Ming, M., **Feng, Z.**, Ling, J., & Xiao, X.H. (2019, October). Disturbance Observer based Model Prediction Control for a 2-DOF Nanopositioning Stage. In IECON 2019-45th Annual Conference of the IEEE Industrial Electronics Society (**IECON 2019**) (Vol. 1, pp. 5211-5216). IEEE. (**EI**)
26. Ling, J., **Feng, Z.**, Ming, M., Guo, Z., & Xiao, X.H. (2018, July). Integrating Damping Control with Iterative Learning Control for Fast and Precise Scanning of Nanopositioners: A TITO Design. In 2018 3rd International Conference on Advanced Robotics and Mechatronics (**ICARM**) (pp. 183-188). IEEE. (**EI**)
27. Ling, J.,**Feng, Z.**, Yao, D., & Xiao, X.H. (2016, July). A Position Domain Iteration Learning Control for Contour Tracking with Application to a Multi-axis Motion Testbed. In 2016 American Control Conference (**ACC**) (pp. 1247-1252). IEEE. (**EI**)
28. Ling, J., **Feng, Z.**, & Xiao, X.H. (2015, August). A Position Domain Cross-coupled Iteration Learning Control for Contour Tracking in Multi-axis Precision Motion Control Systems. In International Conference on Intelligent Robotics and Applications (**ICIRA**) (pp. 667-679). Springer, Cham. (**EI**)